

DEVELOPMENT OF FARM RECORDS SOFTWARE

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Abstract

Farm records are mostly manually kept on paper notebooks and folders where similar records are organized in one folder or spread sheet. These records are usually kept for many years therefore they become bulky and less organized. Consequently, it becomes difficult to search, update and tedious and time consuming to manage these records. This study was carried-out to overcome these problems associated with manual farm records keeping by developing user-friendly, easily accessible, reliable and secured software. The software was limited records keeping in crop production, livestock production, poultry production, employees, income and expenditure. The system was implemented using Java Server Faces (JSF) for designing Graphical User Interface (GUI), Enterprises Java Beans (EJB) for logic tier and MySQL database for storing farm records.

Keywords: farm record, software, farm management decision, development

1. Introduction

To make an accurate and efficient farm management decision, it requires extensive information concerning past records on cost, returns, input use and production. The present financial and physical condition, and future costs, returns and production are also important. This information can all be acquired from farm records (Delton and Robert, 2004). Pena *et al.*, (2002), stated that many farm managers have found keeping and analysing farm records a challenge. In Canada, various farm record-keeping software were developed and evaluated, among which Microsoft Excel and Quicken are popularly used by farm managers. Microsoft Excel used spread sheet to compute and manage farm records, although, it is not purposely developed for farm records keeping. Quicken on the other hand, was developed purposely for farm records keeping, it has good features that makes farm record efficient, but it solely depends on the software installation before it could be used (Klaus, 2006). Therefore, the ideal way to ensure easy access and management of farm records is to develop a user-friendly, zero-install-client, and well secured software, which is incorporated with relational database system. According to preliminary investigations, most farm records in Nigerian are kept using paper notebooks and folders. Similar records are organized in one folder, for instance, sales receipts are organized in one folder and expenses receipts are organized in another. Meanwhile, the problems of this system of keeping farm records are as follows: paper work is tedious and consumed much time; farm record is difficult to update and maintain; it is difficult to search for a record within bunch of papers and folders; records cannot be access from anywhere around the world; records can be loss due to fire accident. In light of the aforementioned problems, the aim of this work is to present a detailed development of farm records software which is a user-friendly, zero-install-client and well secured. Therefore, it needs a web browser and an internet connection. The limitation of the study is that the software will require high speed internet connection and will support only Mozilla Fire-fox, Internet Explorer and Google chrome web browsers for optimum performance and best display.

2. Material and Methods

The methods used were in conformity with the standard stages of waterfall software development method, which According to Forrest and Roseanne (2010) includes the following:

- i. System requirements specification and analysis
- ii. Design
- iii. Implementation
- iv. Testing and debugging

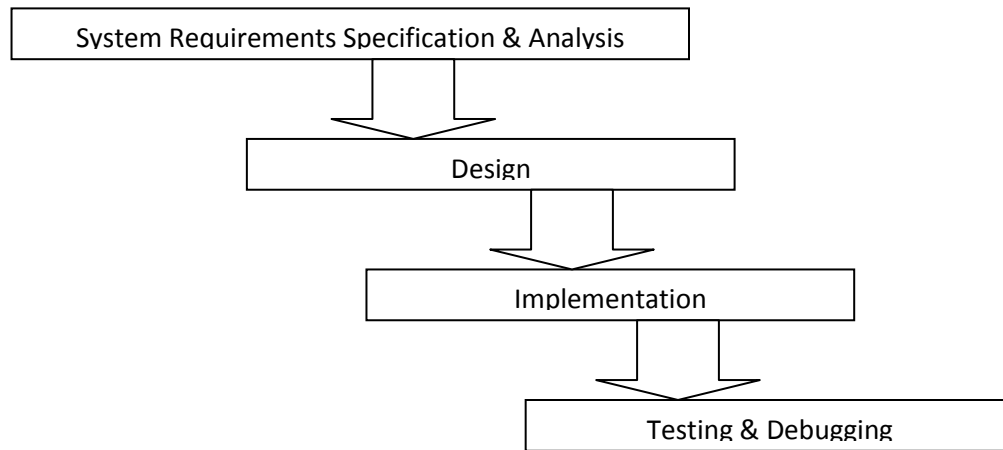


Figure 1: Water fall method diagram (Forrest and Roseanne, 2010)

2.1 System Requirements Specification

The software was developed to satisfy the following requirements.

2.1.1 User Requirements

The user requirements specify the requirements of the user expects from the software to be developed.

1. Zero-install client. ie. requires a minimum of web browser and an internet connection.
2. Grant access to authorized users and deny access to unauthorized users.
3. Easy to learn and user-friendly interface.
4. It is fast.

2.1.2 Functional Requirements

A functional requirement defines the functions of a system or its components. A function is described as a set of inputs, behaviour and outputs. Functional requirements may be calculations, technical details, data manipulation and processing as well as other specific functionality that define what a system supposed to accomplish (Pena *et al.*, 2002).

1. Authenticate user using username and password.
2. Capture data relating to farm records.
3. Ensures a valid data input.
4. Provide for add, delete, update and retrieve functions.
5. Produces reports based on queries obtain from database.

2.1.3 Non Functional Requirements

Non-functional requirements are requirements that specify criteria that can be used to judge the operation of a system, rather than specific behaviours. In contrast, functional requirements define what a system supposed to do and non-functional requirements define how a system supposed to be.

1. Software shall provide login screen for authentication against username and password.
2. Software shall provide forms for data capture.
3. Software shall validate form data before submission.
4. Software shall produce queries results in tabular form.

2.1.4 Hardware Requirements

The software needs certain hardware components or other software resources to be used efficiently. Forrest and Roseanne (2010) stated the followings minimum web-based hardware and software requirements:

1. Random Access Memory (RAM) of 256MB
2. Keyboard
3. Hard disk
4. Coloured screen monitor with minimum processing speed of 1000MHz
5. A printer preferably lesser jet 6P,
6. Network card and mouse.

2.2 System Analysis

The software is divided into different modules as shown in the figure 2 below:

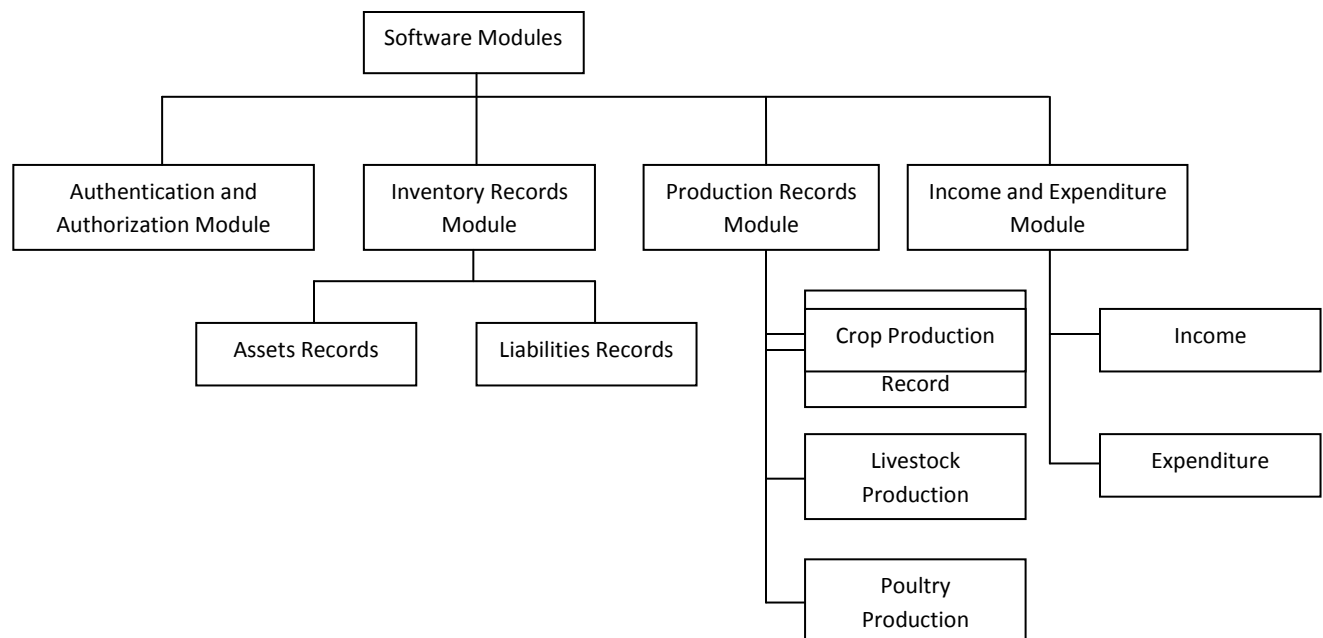


Figure 2: Software modules (Forrest and Roseanne, 2010)

2.3 System Design

In designing the system, the architectural design was used to represent the three levels at which data are described, namely: external level, conceptual level and internal level (Figure 3).

Architectural Design

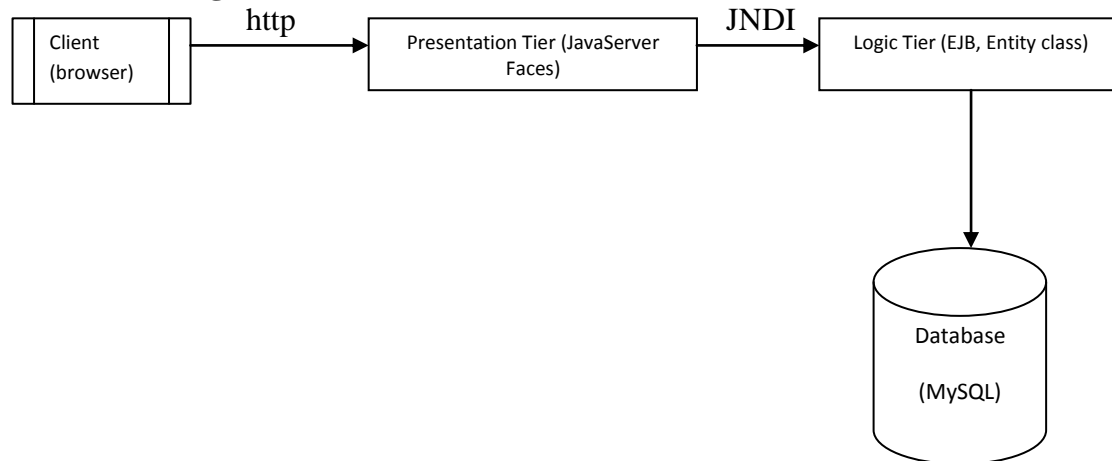


Figure 3: Architectural design (Forrest and Roseanne, 2010)

2.4 Technologies Used

The programming language used in developing the Farm Records Software is Java programming language (David and Cay 2010).

- i. Java Persistent API (JPA): This was introduced into the platform to bridge the gap between object-oriented domain models and relational database, because Java is object-oriented (understands objects only) and database is relational (understands tables and rows only). One of its strengths is that it can be slotted into which ever layer, tier, or framework an application needs it to be in. Therefore, it works effectively with Java Server Faces (JSF) to collect form data and save it to the database.
- ii. Java Server Faces (JSF): This is a component-based framework. By using components, one can think about user interface at a higher level than raw Hypertext Mark-up Language (HTML). I can reuse my own components and use third-party component sets too. JSF contains all the necessary code for event handling and component organization; therefore, one can ignore the details and work on the application logic. However, in this research, PrimeFaces is used as a component suite for JSF which contains rich set of components, built-in ajax API, lightweight mobile UI kit and ajax push support. Also In this research JSF serves as a presentation tier, where forms and other components are rendered on the client browser.
- iii. Enterprises Java Beans (EJB): EJB is a server-side component architecture that simplifies the process of building enterprise-class distributed component applications in Java. By using EJB in this research, one can write scalable, reliable, and secure application without writing my own complex distributed component framework. EJB sits between JPA and JSF and serves as a logic tier to perform authentication (checking for username and password match), multi-threading (processing multiple client requests simultaneously), caching (keeping data around in the server memory to avoid costly network round trips and database

hits), transactions (to avoid database crash when clients access the same row of the database simultaneously, and rollback atomic transaction when failed).

2.5 Tools/Utilities Used

The followings are the tools/utilities used in this study as reported by Mohammed (1999):

- i. MySQL Server: This is the database for storing all farm records. MySQL was used because it is fast, easy to learn, open source, integrate well with java and can handle large volume of data.
- ii. Glassfish Server: This is the server in which the software was deployed. Glassfish server was used because it is compatible with java web framework applications, fast, open source and has a lot of capabilities/features such as monitoring data, mail session and messaging services which allows the extend or improvement of the software when the need arise without redeploying the software to another server.
- iii. Netbeans IDE 7.3: This is an integrated development environment which makes programming easier by using auto-code completion, source code organization and management, and also integrates well with other third party software such as MySQL database, subversion, glassfish server etc.

3. Results and Debugging

The software was run and validated with test data to ensure it produced the desired output. This was done in order to identify and debug any bug that may arise.

Table 1: Login Use-Case

Scenario	Login
Given	I have entered username
And	I have entered password
When	I press login button
Then	I should see my home page

Farm Records Software

Home Login About

Login Information

Username: * admin

Password: * *****

Login

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Figure 4: Login Page



Figure 5: User Home Page

Table 2 -Add Asset Record Use-Case

Scenario	Add Asset Record
When	I press Inventory menu
Then	I should see Assets sub-menu
And	I press Assets sub-menu
Then	I should see New
And	I press New
Then	I should see New Asset form
Given	I have entered item name
And	I have entered description
And	I have entered value
And	I have entered type
And	I have entered category
When	I press save
Then	I should see Asset was successful created

Farm Records Software

Inventory Crop Production Livestock Production Poultry Production Income and Expenditure Manage Users

Assets Liabilities Balance Sheet

+ New Search

Profile Logout

New Asset

Item:

Description:

Value:

Type:

Category:

Save Reset Back

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Figure 6: New Asset Record Page

Table 3 - Search Assets Records Use-Case

Scenario	Search Assets Records
When	I press Inventory menu
Then	I should see Assets sub-menu
And	I press Assets sub-menu
Then	I should see Search
And	I press Search
Then	I should see all farm assets

Farm Records Software

Inventory Crop Production Livestock Production Poultry Production Income and Expenditure Manage Users

Welcome admin

Profile Logout

Farm Assets Records

Assets

Id	Item Name	Item Description	Item Value	Type	Category	Perform Action
1	Storage Bin I	Grain Storage Bin I	₦500,000.00	Fixed	Building	View Edit Delete
2	Storage Bin II	Grain Storage Bin II	₦800,000.00	Fixed	Building	View Edit Delete
3	JM Tractor	Jigawa Tractor	₦5,000,000.00	Current	Machinery/Equipment	View Edit Delete
4	Combine Harvester	Combine Harvester	₦10,000,000.00	Intermediate	Machinery/Equipment	View Edit Delete
5	Ridger	Ridger	₦150,000.00	Intermediate	Machinery/Equipment	View Edit Delete

Total Assets: 5
Total Assets Value: ₦16,450,000.00

Print

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Figure 7: Search Asset Records Page

Table 4 - Add Liability Record Use-Case

Scenario	Add Liability Record
When	I press Inventory menu
Then	I should see Liabilities sub-menu
And	I press Liabilities sub-menu
Then	I should see New
And	I press New
Then	I should see New Liability form
Given	I have entered item name
And	I have entered description
And	I have entered value
And	I have entered type
And	I have entered category
When	I press save
Then	I should see Liability was successfully created

The screenshot displays the 'Farm Records Software' interface. At the top, there's a navigation bar with a logo and a menu containing 'Inventory', 'Crop Production', 'Livestock Production', 'Poultry Production', 'Income and Expenditure', and 'Manage Users'. Below this, a 'Welcome admin' message is shown next to 'Profile' and 'Logout' links. The main content area features a 'New Liability' form with the following fields: 'Item' (text input), 'Description' (text area), 'Value' (text input), 'Type' (dropdown menu), and 'Category' (dropdown menu). At the bottom of the form are three buttons: 'Save', 'Reset', and 'Back'. The footer of the page states: '© 2013 Department of Agricultural Engineering, Faculty of Engineering, Bayero University, Kano. All rights reserved.'

Figure 8: New Liability Record Page

Table 5 - Search Liabilities Records Use-Case

Scenario	Search Liabilities Records
When	I press Inventory menu
Then	I should see Liabilities sub-menu
And	I press Liabilities sub-menu
Then	I should see Search
And	I press Search
Then	I should see all farm liabilities.

Farm Records Software

Inventory Crop Production Livestock Production Poultry Production Income and Expenditure Manage Users

Assets
Liabilities
Balance Sheet

+ New
Search

Profile Logout

Farm Liabilities Records

Id	Item	Description	Value	Type	Category	Perform Action
1	Bank Loan	Bank Loan	₦5,000,000.00	Long Term Liabilities	Mortgage	View Edit Delete
2	Borrow Money From Friend	Borrow money from friend	₦100,000.00	Current	Cash/Notes	View Edit Delete
3	Tractor Loan	Tractor loan	₦3,000,000.00	Intermediate Liabilities	Other	View Edit Delete

Total Liabilities: 3
Total Liabilities Value: ₦8,100,000.00

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Figure 9 - Search Liabilities Records Page

Table 6 - Balance Sheet Use-Case

Scenario	Balance Sheet
When	I press Inventory menu
Then	I should see Balance Sheet
When	I press Balance Sheet
Then	I should see farm balance sheet

Farm Records Software

Inventory Crop Production Livestock Production Poultry Production Income and Expenditure Manage Users

Assets
Liabilities
Balance Sheet

Profile Logout

Balance Sheet

Assets				Liabilities			
Id	Item	Value	Category	Id	Item	Value	Category
1	Storage Bin I	₦500,000.00	Building	1	Bank Loan	₦5,000,000.00	Mortgage
2	Storage Bin II	₦800,000.00	Building	2	Borrow Money From Friend	₦100,000.00	Cash/Notes
3	JM Tractor	₦5,000,000.00	Machinery/Equipment	3	Tractor Loan	₦3,000,000.00	Other
4	Combine Harvester	₦10,000,000.00	Machinery/Equipment				
5	Ridger	₦150,000.00	Machinery/Equipment				

Total Assets: 5
Total Assets Value: ₦16,450,000.00

Total Liabilities: 3
Total Liabilities Value: ₦8,100,000.00

Net Worth: ₦8,350,000.00

Print Balance Sheet

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Figure 10: Balance Sheet

Table 7 - Add Field Use-Case

Scenario	Add Field
When	I press Crop Production menu
Then	I should see Field sub-menu
When	I press New
Then	I should see New Field form
Given	I entered Field Name
And	I entered Field Area
When	I pressed Save
Then	I should see Field created successfully
When	I pressed field sub-menu
Then	I should see Field Activities sub-menu
When	I pressed New
Then	I should see New Field Activity form
When	I select the field
And	I select the activity
And	I select the activity supervisor
And	I select the date of activity
When	I pressed Save
Then	I should see field activity saved successfully
When	I pressed Field sub-menu
And	I pressed Field Input sub-menu

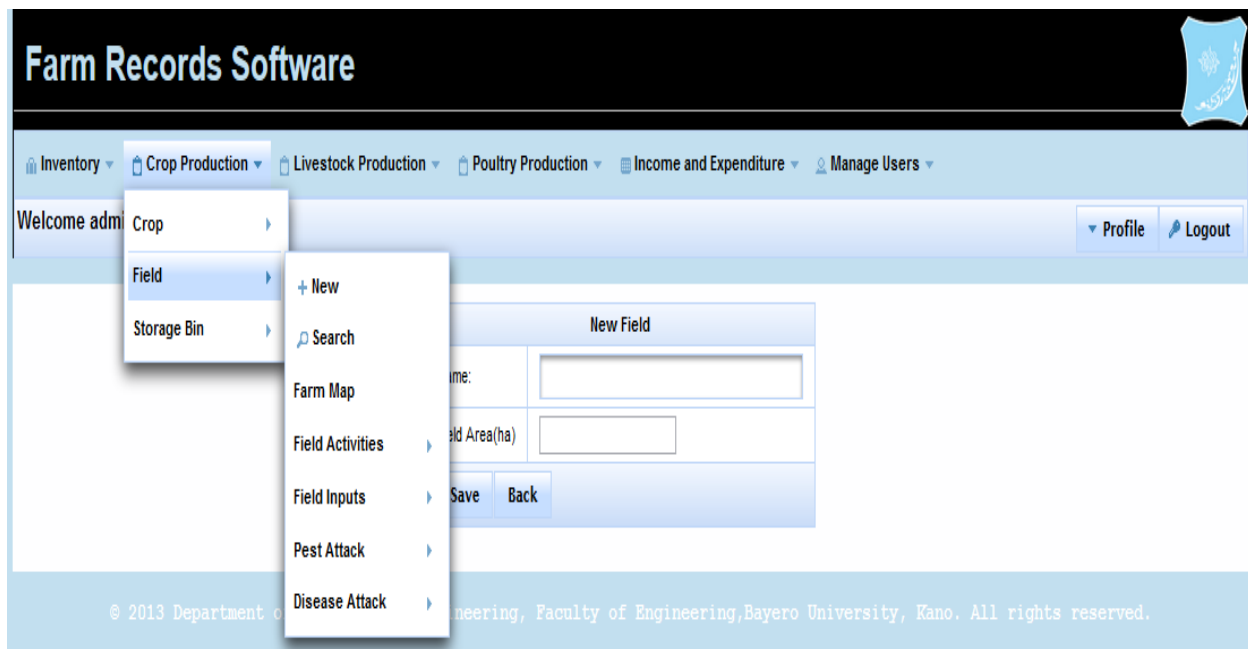


Figure 11: New Field Record Page

Table 8: New Field Activity Use-Case

Scenario	New Field Activity
When	I pressed field sub-menu
Then	I should see Field Activities sub-menu
When	I pressed New
Then	I should see New Field Activity form
When	I select the field
And	I select the activity
And	I select the activity supervisor
And	I select the date of activity
When	I pressed Save
Then	I should see field activity saved successfully

The screenshot displays the 'Farm Records Software' web application. At the top, there's a navigation bar with menu items: Inventory, Crop Production, Livestock Production, Poultry Production, Income and Expenditure, and Manage Users. Below this, a 'Welcome admin' message is shown alongside 'Profile' and 'Logout' links. The main content area features a 'New Field Activity' form with the following fields: 'Field' (dropdown), 'Activity' (dropdown), 'Monitored By' (dropdown), and 'Date' (calendar icon). At the bottom of the form are 'Save' and 'Back' buttons. The footer contains the copyright notice: '© 2013 Department of Agricultural Engineering, Faculty of Engineering, Bayero University, Kano. All rights reserved.'

Figure 12: New Field Activity Record Page

Table 9: New Field Input Use-Case

Scenario	New Field Input
When	I pressed Field sub-menu
And	I pressed Field Input sub-menu
And	I pressed New
Then	I should see New Field Input form
When	I select the field
And	I select the input type
Given	I entered the Application Method
And	I entered Application Rate
When	I select Date
And	I pressed Save
Then	I should see Field input saved successfully

Farm Records Software

Inventory Crop Production Livestock Production Poultry Production Income and Expenditure Manage Users

Welcome admin Profile Logout

New Field Input

Field:

Input:

Method:

Application Rate:

Date:

Save Back

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Figure 13: New Field Input Record Page

Table 10: Field History Use-Case

Scenario	Field History
When	I pressed field sub-menu
And	I pressed Search
Then	I should see all fields
When	I pressed View
Then	I should see field detail and activities history

Farm Records Software

Inventory Crop Production Livestock Production Poultry Production Income and Expenditure Manage Users

Welcome admin Profile Logout

Field Records

Field Information

Id:	1
Name:	Field 1
Field Area(ha)	10,000.00

Field Activities Records

Id	Activity	Date	Monitored By
1	Tillage	13/12/2013	Imrana Zango (Crop Production)

Field Input Records

Id	Input	Method	ApplicationRate	ApplicationDate
1	Fertilizer	Broadcast	50.0	14/12/2013

Disease Attack Records

Id	Disease	Damage Rate	Date
No disease damage record found.			

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Figure 14: Field Detail Page

Table 12: Add Crop Record Use-Case

Scenario	Add Crop Record
When	I pressed Crop Production menu
And	I pressed Crop sub-menu
And	I pressed New sub-menu
Then	I should see New Crop form
Given	I entered Crop Name
And	I entered Crop Description
When	I select Crop Type
And	I select Field
And	I pressed Save button
Then	I should see Crop saved successfully

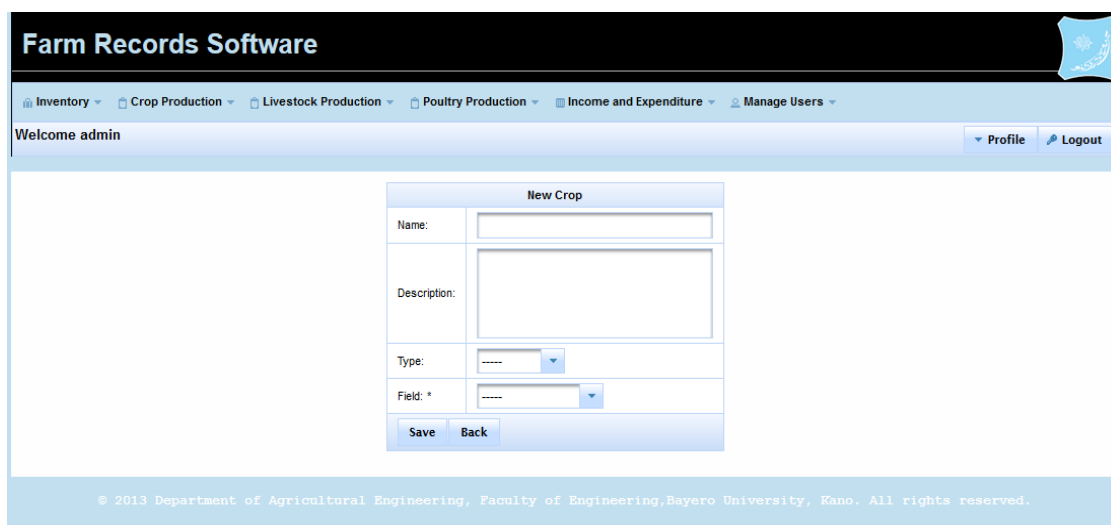
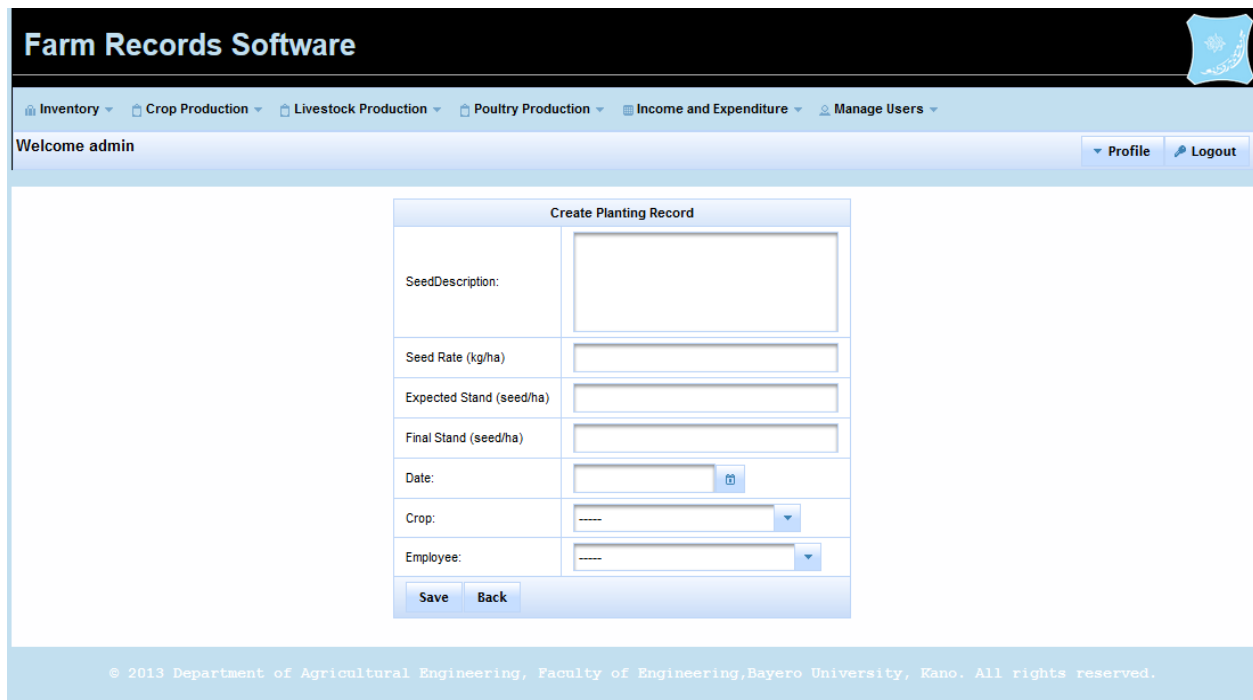


Figure 15: New Crop Record Page

Table 13: Add Crop Planting Record Use-Case

Scenario	Add Crop Planting Record
When	I pressed Crop Production menu
And	I pressed Crop sub-menu
And	I pressed Planting sub-menu
And	I pressed New
Then	I should see New Planting Record form
Given	I entered Seed Description
And	I entered Seed Rate
And	I entered Expected Stand
When	I select Planting Date
And	I select the Crop
And	I select the Agronomist
And	I pressed Save button
Then	I should see Planting Record saved successfully



Farm Records Software

Inventory Crop Production Livestock Production Poultry Production Income and Expenditure Manage Users

Welcome admin Profile Logout

Create Planting Record

SeedDescription:

Seed Rate (kg/ha)

Expected Stand (seed/ha)

Final Stand (seed/ha)

Date:

Crop:

Employee:

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Figure 16: New Planting Record Page

Table 14: Add Crop Harvesting Record Use-Case

Scenario	Add Crop Harvesting Record
When	I pressed Crop Production menu
And	I pressed Crop sub-menu
And	I pressed Harvest sub-menu
And	I pressed New
Then	I should see New Harvest form
When	I select Crop
And	I select Agronomist
Given	I entered the Quantity (Bags)
And	I select Harvest Date
And	I pressed Saved
Then	I should see Harvest record saved successfully

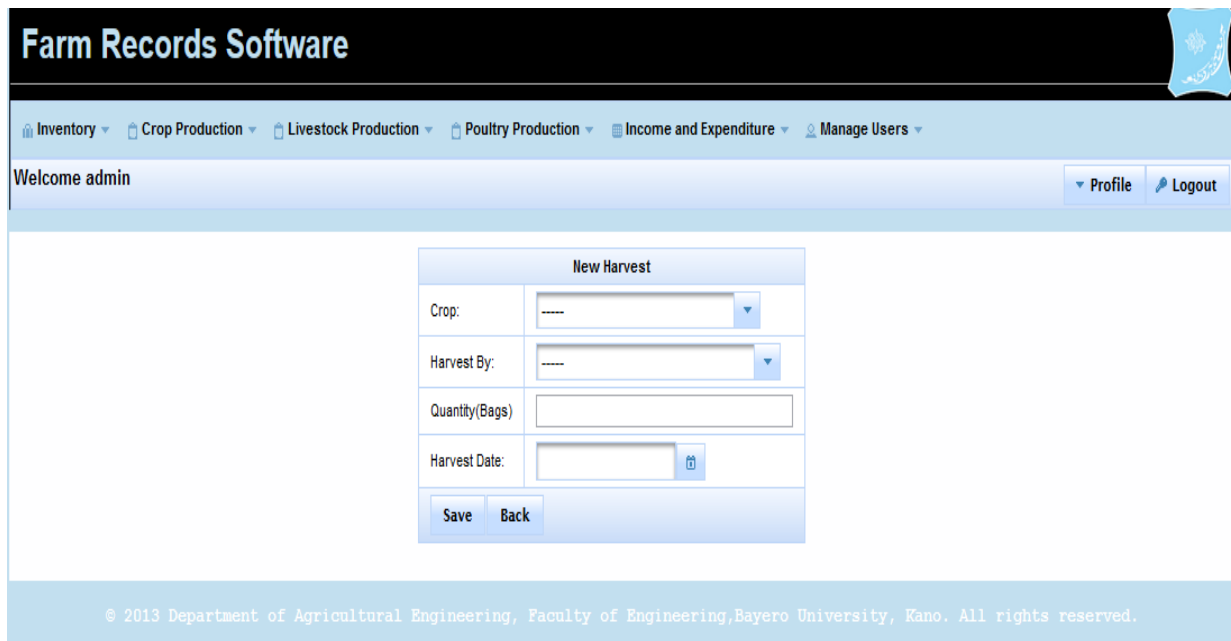


Figure 17: New Harvest Record Page

Table 15: Add Crop Storage Record Use-Case

Scenario	Add Crop Storage Record
When	I pressed Crop Production menu
And	I pressed Crop sub-menu
And	I pressed Storage sub-menu
And	I pressed New
Then	I should see New Storage form
When	I select Crop
And	I select Supervisor
And	I select Storage Bin
Given	I entered the Quantity (Bags)
And	I select Storage Date
And	I pressed Save button
Then	I should see Storage record saved successfully

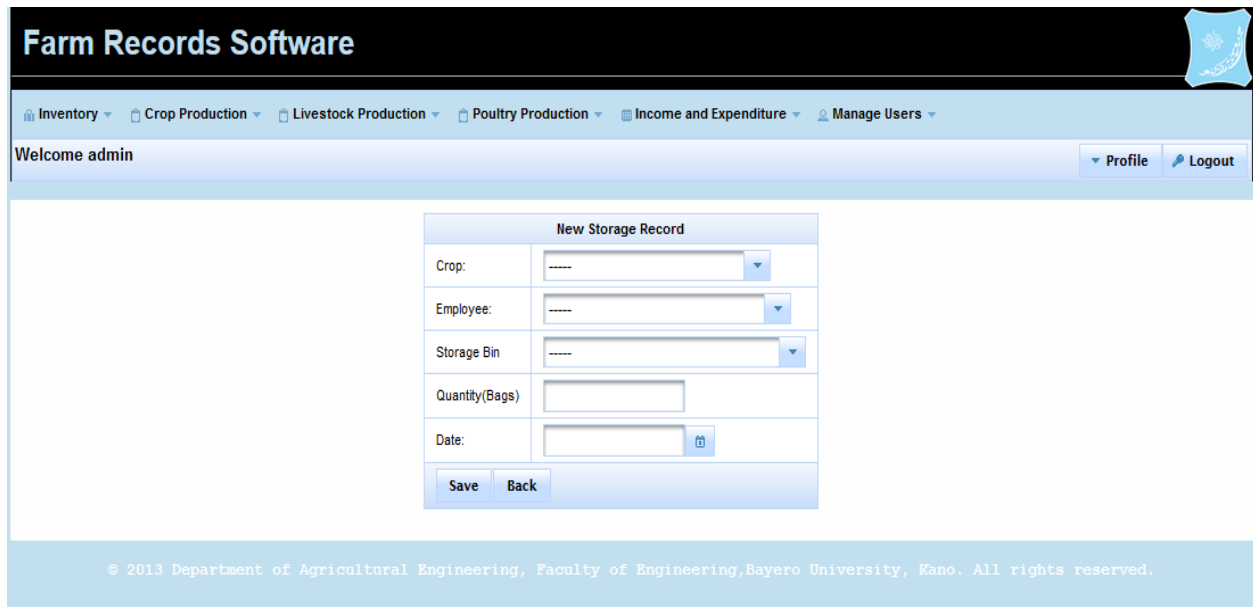


Figure 18: New Storage Record Page

Table 16: Add Herd Record Use-Case

Scenario	Add Herd Record
When	I pressed Livestock Production menu
And	I pressed Herd sub-menu
And	I pressed New
Then	I should see New Herd form
Given	I entered Tag
When	I select Category
And	I select Breed
And	I select Herd Man
Given	I entered Size
And	I entered Value
When	I pressed Save button
Then	I should see Herd saved successfully

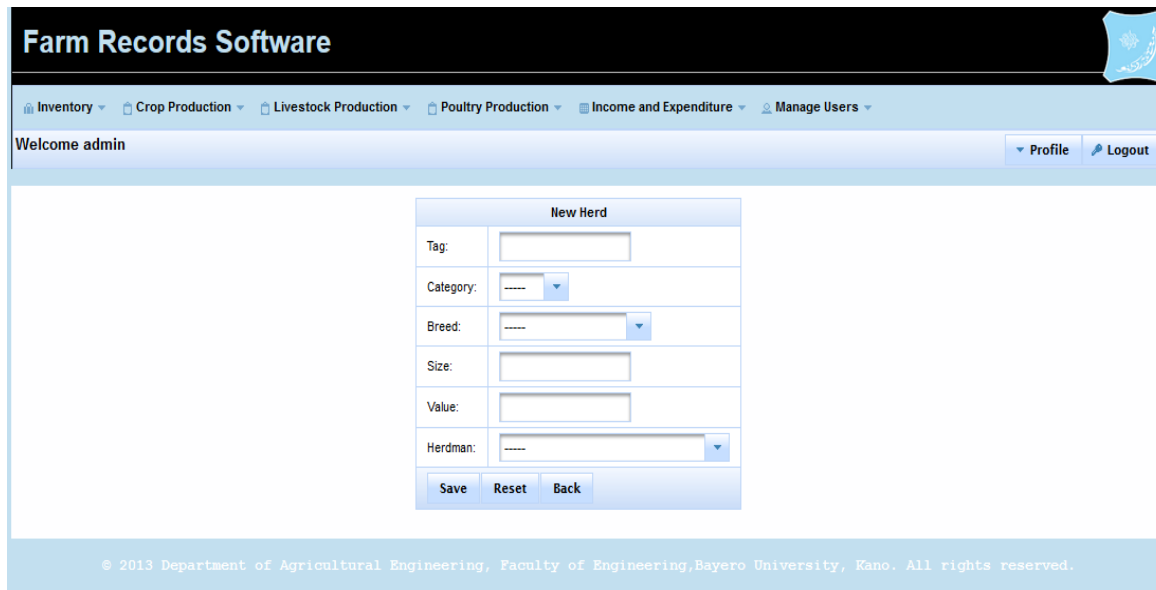


Figure 19: New Herd Record Page

Table 17: Add Income Record Use-Case

Scenario	Add Income Record
When	I pressed Income and Expenditure menu
And	I pressed Income sub-menu
And	I pressed New
Then	I should see New Income form
Given	I entered income description
And	I entered amount
And	I select date
And	I pressed save button
Then	I should income record saved successfully

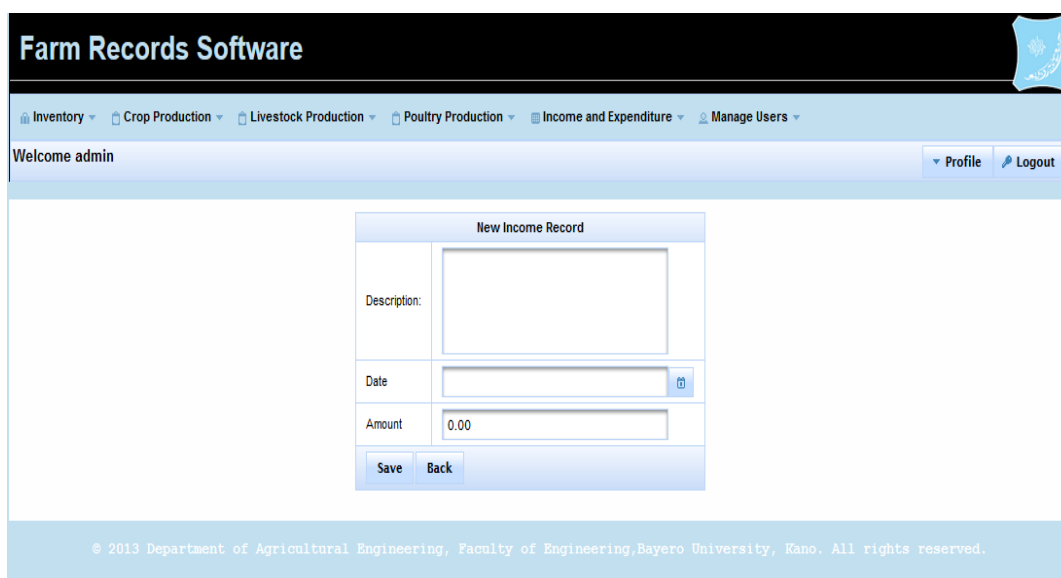


Figure 20- New Income Record Page

Table 18: Add Expenditure Record Use-Case

Scenario	Add Expenditure Record
When	I pressed Income and Expenditure menu
And	I pressed Expenditure sub-menu
And	I pressed New
Then	I should see New Expenditure form
Given	I entered expenditure description
And	I entered amount
And	I select date
And	I pressed save button
Then	I should expenditure record saved successfully

The screenshot displays the 'Farm Records Software' interface. At the top, there's a navigation bar with dropdown menus for 'Inventory', 'Crop Production', 'Livestock Production', 'Poultry Production', 'Income and Expenditure', and 'Manage Users'. Below this, a 'Welcome admin' message is shown on the left, and 'Profile' and 'Logout' links are on the right. The main content area features a 'New Expense Record' form. This form includes a 'Description' field, a 'Date' field with a calendar icon, and a 'Cost' field with a value of '0.00'. At the bottom of the form are 'Save' and 'Back' buttons. The footer of the page states: '© 2013 Department of Agricultural Engineering, Faculty of Engineering, Bayero University, Kano. All rights reserved.'

Figure 21: New Expenditure Record Page

Table 19: View Income Statement Use-Case

Scenario	View Income Statement
When	I pressed Income and Expenditure menu
And	I pressed Income Statement
Then	I should see Income Statement

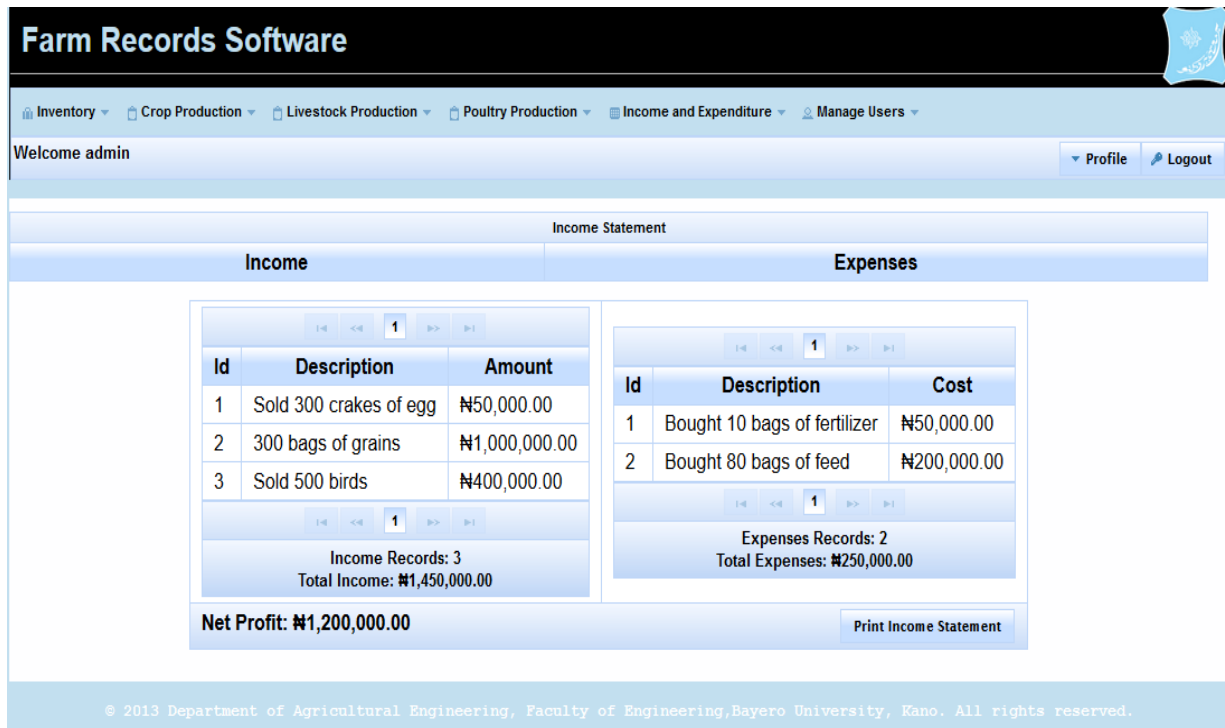


Figure 22: Income Statement

Table 20: Add New Employee Record Use-Case

Scenario	Add New Employee Record
When	I pressed Manage Users menu
And	I pressed Employee sub-menu
And	I pressed New
Then	I should see New Employee form
Given	I entered first name
And	I entered surname
And	I select gender
And	I entered phone number
And	I entered address
And	I entered Salary/Wage
And	I select employment date
And	I select area of specialization
And	I pressed Save
Then	I should see employee saved successful

Farm Records Software

Inventory Crop Production Livestock Production Poultry Production Income and Expenditure Manage Users

Welcome admin Profile Logout

New Employee

Firstname:

Surname:

Gender:

Phone:

Address:

Salary/Wage:

Employed Date:

Specialization:

Save Reset Back

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Figure 23: New Employee Record Page

Table 21: Search Employee Records Use-Case

Scenario	Search Employees Record
When	I pressed Manage Users menu
And	I pressed Employee sub-menu
And	I pressed Search
Then	I should see all employees records

Farm Records Software

Inventory Crop Production Livestock Production Poultry Production Income and Expenditure Manage Users

Welcome admin Profile Logout

Employees Record

Id	Firstname	Surname	Gender	Phone	Specialized	Employed Date	Perform Action
1	Adam	Bilyamin	Male	07037712291	Agric Engineering	11/12/2013	View Edit Delete
2	Imrana	Zango	Male	08068893839	Crop Production	11/12/2013	View Edit Delete
3	Ilyasu	Musa	Male	08045897788	Herdman	22/05/2014	View Edit Delete

Number of Employees: 3

Print

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Figure 24: Search Employees Records Page

4. Conclusion

The study was carried out to address the problems of farm records keeping and management in farm. User-friendly farm record software has been developed successfully which can be relied upon to produce and record accurate information and also adequately protected against unauthorized access and/or manipulation.

The objective has been achieved. The system developed:

- i. Is user-friendly
- ii. Is easy to manage record (add, update, delete and search for record)
- iii. Is adequately protected against unauthorized access.

5. Recommendation

The system developed was limited to crop production, livestock production and income/expenditure records keeping system. Therefore, it is recommended other farm production sections such as fisheries should be incorporated. It is also recommended that a web service should be implemented to expose the records of feeds, fertilizer and other farm inputs that need to be supplies by other third party so that suppliers can access these records and immediately arrange for supply when the remaining quantity is low, as specified by the farm manager.

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